DECLARATION

I, Jeffrey C. Barfield of Alpenrosenstrasse 3, 82377 Penzberg, Germany, do hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof.

I verify that the attached English translation is a true and correct translation of the German language patent application with the international publication number WO 2004/022843 A1 and the international file reference PCT/EP2003/008445.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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A method for treating pulp

The invention relates to a method for treating pulp in accordance with the preamble of claim 1.

Methods for treating pulp of the aforesaid type are generally also designated as refining processes. It has been known for a long time that pulp fibers have to be refined so that the paper later manufactured from them has the desired properties, in particular strengths, formation and surface. The absolutely most used refining processes use such refining surfaces which are provided with rails known as blades. The corresponding machines are mostly called blade refiners. For special cases, refining processes are also used in which at least one of the refining surfaces is bladeless so that the refining work is transmitted by frictional forces or shear forces.

The effect of the process can be controlled in a wide range by changing the refining parameters, with - in addition to the amount of the extraction - in particular a difference also being made as to whether a refining is desired which cuts more strongly or fibrillates more strongly. If pulp fibers are processed by the known refining processes, their dewatering resistance increases as the extraction increases. A customary measure for the dewatering resistance is the freeness according to Schopper-Riegler.

Increasing the freeness has an unfavorable effect on the formation on the paper making machine, but is accepted, since the already named quality features of the pulp play an exceptional role for its usability. In many cases, the refining parameters are selected such that the increase in freeness occurring to reach the required fiber quality is as low as possible.

This influence possibility is, however, very limited. In addition, the refining can thereby become less favorable from a force-economic aspect.

It is the underlying object of the invention to provide a method for pulp treatment with which it is possible to alter pulp fibers or paper fibers such that the strengths of the paper made therefrom are increased. The increase in the dewatering resistance which occurs in this process should be at least lower than with known refining processes.

This object is satisfied by the features named in claim 1.

The new refining process substantially works such that a refining shear loading of the pulp fibers is avoided to the largest extent. Three important advantages are thereby substantially achieved with respect to the known refining processes:

1. The fiber length is maintained substantially better.

2. The fiber surface is not fibrillated or is fibrillated significantly less.

3. The specific refining work to achieve the desired strengths is generally less.

Comparative trials with long fiber pulp have shown that to achieve a tear length of 8 km, 45° SR freeness occurred in a blade refining and with the new process only 18° SR. The required specific refining work was up to 50% lower.

It is to be assumed that the surface of the fibers is changed by the new refining process such that it is given an improved flexibility and binding

capability without fibrils having to be removed from the outer surface of the fibers. The production of fines, that is of fiber fractions, can also be omitted.

If the process is used on recycled fibers, the advantages named under 1. and 2. play a special role. Recycled fibers have already undergone at least one, frequently even several refining processes so that any further crushing is willingly avoided.

The invention and its advantages will be explained with reference to drawings. There are shown:

Fig. 1 a simple example for the carrying out of the method in accordance with the invention;

Fig. 2 schematically: an apparatus for the carrying out of the method;

Fig. 3 a variation of the roll structure;

Fig. 4 schematically in the position of use: a further apparatus for the carrying out of the method;

Fig. 5 a qualitative strength diagram.

The representation in Fig. 1 can be considered as a view from above of part of an apparatus particularly suited for the carrying out of the method. However, no technical design details are shown. The refining surface 1 is located in accordance with this representation on the outer periphery of a rotating refining body 9. The refining surface 2, as the inner side of a

likewise rotating refining drum 8, carries the pulp F to be refined, that is the watery suspension containing the paper fibers or pulp fibers, on its inner side. It is uniformly distributed on the refining surface 2 and rotates on and along with it due to the centrifugal forces. The peripheral speed of the refining body 9 is indicated by a direction arrow 6 and that of the refining drum 8 is indicated by a direction arrow 7. The kinematics of these two refining surfaces in accordance with the invention is such that at the position 5, at which the two refining surfaces approach one another the most, a very low speed arises between the pulp F and the refining surfaces in the direction of the main movements of the refining surfaces. The main movement directions arise by movement of the refining surfaces due to the drive. The refining body 9 in this process rolls off the inner side of the refining drum 8. The axis of rotation of the refining body 9 is parallel to that of the refining drum 8 and can be spatially fixed. The actual refining zone 3 starts at the position at which the refining surface 1 dips into the layer of the pulp F. To produce a compression force, the refining body 9 is pressed toward the refining surface 2 with the force P. The refining effect can be adjusted by changing this force. Line forces between 2 and 10 N/mm have proven advantageous. With this figure, the force is related to the width of the contacting refining bodies without taking into account the expansion of the contact surface in the running direction. A fiber treatment thereby arises in the refining zone 3 with compression and crushing processes which flexibilize the fibers in a very gentle manner. No real shearing forces or even cutting forces are transmitted to the fibers.

The refining surface 1 is provided here with grooves 4 whose effect cannot be compared with that of blades of known blade refiners in which the blades are moved relative to one another at high speed. The grooves 4 produce pressure pulses in cooperation with the counter surface which serve e.g. for the water absorption of the fibers. They also provide the

transport of the pulp F through the refining zone 3. The grooves can extend over the full axial length of the refining body; however, they can also be interrupted. The depth t and the width u should generally amount to at least 2 mm. Deviations from the rectangular structure shown here are also feasible, as Fig. 3 shows by way of example with reference to a trapezoidal structure.

An apparatus for the carrying out of the method could generally be made such as Fig. 2 shows in the position of use. A horizontally arranged refining drum 8 can be seen which is set into rotation via the drive 11. A plurality of refining bodies 9 are located inside this refining drum and - as has already been described - are moved such that a roll-off movement takes place at the contact positions to the refining drum 8. The refining bodies 9 are set into rotation by the drive 10, with their axes of rotation being perpendicular and spatially fixed. The added pulp F can be refined step-wise with such an apparatus and can be removed after the refining process as extracted pulp F'. If such an apparatus should be operated continuously, measures must be taken which effect a constant throughput of the pulp such that a uniform refining takes place.

Another possibility of carrying out the method is shown in Fig. 4 in which the center lines of the refining drum 8 and of the refining bodies 9 are horizontal. This apparatus allows continuous refining, which requires, however, that the desired extraction is already achieved with a few passages through a refining zone. A broad layer of the pulp F to be refined is poured into the stationary refining drum 8 such that it runs down the inner wall of the refining drum due to gravity. The refining body 9 rolls off the inner wall of the refining drum 8 in that the movement of rotation (direction arrow 6) of the refining body 9 about its axis is superimposed on a movement of rotation (direction arrow 6') of the axis of the refining body

9 about the center line of the refining drum 8. As a rule, such an apparatus includes a plurality of refining bodies 9 which are supported on a rotating rack. By selecting the addition and removal stations of the pulp F, its flow speed can be regulated. The refining bodies can run counter to the flow of the pulp (as drawn here) or follow it.

The improvement which can be achieved by the new process is indicated in a schematic diagram in accordance with Fig. 5. This diagram shows the freeness (arrow 12), drawn over the tear length (arrow 13). The curve 14 shows the result of a conventional blade refining and the curve 15 a result achieved with the new method. It can easily be seen that much lower freeness is produced to achieve a desired high tearing length in accordance with the new method. This diagram is only intended to show a basic trend.